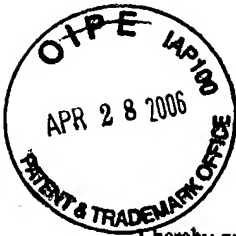


04/18/2006 TUE 16:14 FAX 612 884 2500 MICRON TECHNOLOGY INC

002/003



## PATENT

I hereby certify that on the date specified below, this correspondence is being deposited with the United States Postal Service as first-class mail in an envelope addressed to Mail Stop Amendment, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Date

Ayesha J. Shaikh

## IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appl. No. : 10/625,132

Confirmation No. : 8276

Applicant : Joseph M. Jeddeloh

Filed : July 22, 2003

Attorney Docket No.: 501304.01

Art Unit : 2182

Customer No. : 27,076

Examiner : Bron J. Sorrell

Title : APPARATUS AND METHOD FOR DIRECT MEMORY ACCESS IN A HUB-BASED MEMORY SYSTEM

Mail Stop Amendment  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

DECLARATION UNDER 37 C.F.R. § 1.131

Sir:

I, Joseph M. Jeddeloh, do hereby declare as follows:

1. I am the sole inventor of U.S. Patent Application No. 10/625,132, filed July 22, 2003.
2. I am employed by Micron Technology as a design engineer in their department for Advanced System Technology Development.
3. I conceived of the invention claimed in at least claims 1, 8, 13, and 24 in the United States prior to April 28, 2003. As evidence of my conception of the claimed invention, I attach hereto Exhibit A.
4. Exhibit A is a redacted copy of an invention disclosure document that I submitted to Micron Technology's Patent Review Committee prior to July 22, 2003, for review and consideration for a patent application. Dates and other information not relevant to establishing the date of invention have been marked out in the copy sent to the U.S. Patent and Trademark Office.

The invention disclosure document includes a brief description of the invention, a description of the advantages such an invention has over the previous technology, and a summary and diagrams of embodiments of the invention.

5. As shown in the diagrams of the invention disclosure document, a memory module includes a plurality of memory devices and a memory hub. The memory hub includes a link interface, memory device interface, a switch, and a DMA controller.

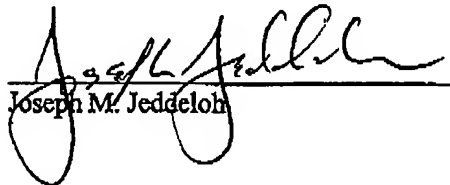
6. The DMA controller is described as being "able to move blocks of data from one location to any other location in memory." Functionality and operation of an embodiment of the DMA controller is described in the invention disclosure document as well.

7. The invention was constructively reduced to practice by filing the present application on July 22, 2003.

8. From a time prior to April 28, 2003 to when the present application was filed, I worked with Kimton N. Eng, the patent attorney designated by Micron Technology to prepare the patent application, to finalize a draft for filing. I considered the review of the drafts as part of my job responsibilities, and consequently, during this time I reviewed drafts of the patent application that Mr. Eng prepared and provided him with my comments and edits in the regular course of my work.

9. I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further, that these statements were made with the knowledge that the making of willfully false statements and the like is punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and may jeopardize the validity of any patent issuing thereon.

4/18/06  
Date

  
Joseph M. Jeddeloh

**Micron Technology, Inc.**  
Invention Disclosure



If this disclosure is related to an ARPA project, please check one of the following:

☐ Advanced SRAM    ☐ BST    ☐ FED    ☐ FE RAM    ☐ NCAICM

1) **INVENTOR(s):** Joseph M Jeddelloh

If an inventor is NOT employed by Micron identify the inventor and employer:

2) **DESCRIPTION OF THE INVENTION:**

2.1 Title of Invention:

Memory Hub with DMA

2.2 Brief Description of Invention:

Memory DIMM contains DMA capability within the memory hub. Memory system is able to move blocks of data in a scatter / gather fashion without processor or IO intervention.

2.3 Attach a complete description, including drawings or sketches and articles relevant to the invention. Legible photocopies of laboratory notebooks are acceptable.

See attached

3) **INFORMATION CONCERNING CONCEPTION OF INVENTION:**

3.1 Conception and Documentation of the Invention:

a. Identify the date when you first conceived the invention.  
(If not sure, give the earliest date of which you are sure)

[REDACTED]

b. To whom was the idea first described and on what date?  
(Other than co-inventor)

[REDACTED]

c. Identify the date of the first tangible record such as computer simulation, tape out, drawing, or written description. Please type and location.

[REDACTED]

3.2 Conception of the Invention:

- a. Identify any related invention disclosures, patents, or other publications describing similar ideas, and other companies working in the same field. Attach copies if available.  
Earlier Memory Hub patents by Joe Jeddeloh and Terry Lee
- b. What is the closest technology, of which you are aware?  
Unkown
- c. Identify the advantages of this invention over previous technology.  
Creates intelligent memory channel. Allows DIMM to DIMM memory transfers without processor intervention thus improving overall system bandwidth.

3.3 Important Dates:

- a. Has the invention been disclosed outside the company ☐ YES ☒ NO  
If yes, to whom, when, and in what form was the invention disclosed?
- b. Have any articles describing your invention been published? ☐ YES ☒ NO  
If yes, list author(s), title of the article, name of publication, and date?
- c. Have any engineering samples been given out? ☐ YES ☒ NO  
If yes, to whom and on what date?
- d. Has any product using the invention been sold or offered for sale?  
☐ YES ☒ NO If yes, to whom and on what date?

3.4 Disposition of the Invention:

- a. When will (or did) Micron begin use of the invention experimentally?  
██████████
- b. When will (or did) Micron begin production of this invention?  
██████████

3.5 Miscellaneous Information:

- a. Was the invention developed during a joint development agreement or other contract with an outside company? ☐ YES ☒ NO
- b. Please list developmental work outside of the company (including government proposal or contract)

4) **INVENTOR(S):**

Name: Joseph M. Jeddelloh

Micron Phone: [REDACTED]

Mail Stop:

Department: Advanced System Technology Development Dept #:

Company Name (*Very Important*):

- ☒ Micron Technology, Inc.  
☐ Micron Technology (Texas)  
☐ Micron Technology, Italia  
☐ Other

- ☐ Micron Communications, Inc.  
☐ Rendition  
☐ Micron Semiconductor Asia

Home Address: [REDACTED]  
[REDACTED]  
[REDACTED]

Citizenship: USA

Supervisor: [REDACTED]

Signature: *Joseph M. Jeddelloh*

Date: [REDACTED]

*(all inventors must sign and date this disclosure form before it can be accepted)*

Name:

Micron Phone:

Mail Stop:

Department:

Dept #:

Company (Very Important):

- ☒ Micron Technology, Inc.  
☐ Micron Technology (Texas)  
☐ Micron Technology, Italia  
☐ Other

- ☐ Micron Communications, Inc.  
☐ Rendition  
☐ Micron Semiconductor Asia

Home Address:

Citizenship:

Supervisor: Terry Lee

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

*(all inventors must sign and date this disclosure form before it can be accepted)*

Name:

Micron Phone:

Department:

Mail Stop:

Dept #:

Company (Very Important):

- ☐ Micron Technology, Inc.  
☐ Micron Technology (Texas)  
☐ Micron Technology, Italia  
☐ Other

- ☐ Micron Communications, Inc.  
☐ Rendition  
☐ Micron Semiconductor Asia

Home Address:

Citizenship:

Supervisor:

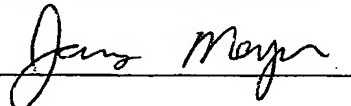

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

*(all inventors must sign and date this disclosure form before it can be accepted)*

*(for additional inventors copy the previous the page)*

**5) WITNESS:**

If there is only one inventor, a witness should sign and date this disclosure. A witness in this case is a non-inventor who understands the nature of the invention.

Signature:  Date: 

**Note:** *If you have any questions or you need assistance completing this form, please call the Patent Department, ext. 84520.*

## Memory Hub with DMA

Often times in a computer system, the processor is required to move a memory block once it has been loaded by another agent. This invention adds a DMA (direct memory access) controller to a memory hub. Each DIMM in the system contains an intelligent memory hub. The memory hub is able to move blocks of data from one location to any other location in memory. The DMA engine is able to read a link list in memory to execute the memory moves without processor intervention. This frees the processor and its bandwidth limiting bus from having to execute the move operations.

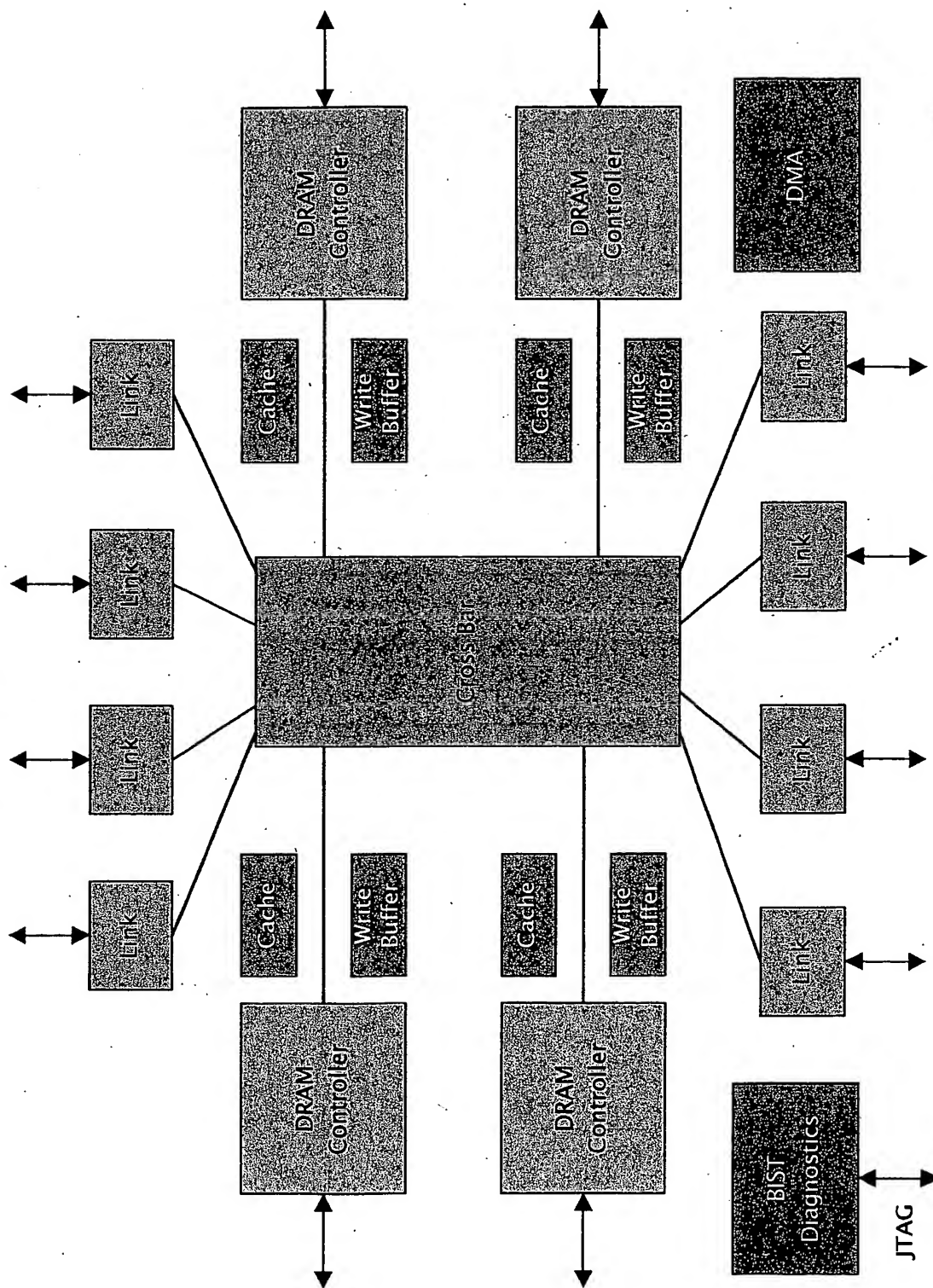
The processor writes a list of instructions in main memory for the DMA engine to execute. These include starting address of the block to move, ending address or count, destination address and the address of the next command block. The DMA engine will execute a series of continuous commands then jump to the next command list.

Completion status could be contained in an IO register in the hub. A start bit could also be used to begin the DMA operation.

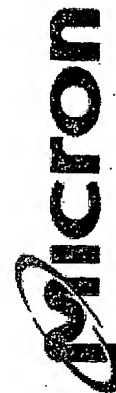
The Embedded DMA controller is programmed through a data structure that exists in one or more memory spaces. The data structure consists of some number of command blocks that provide information necessary to perform data transfer operations. Each of these command blocks is connected through a series of address pointers to form a linked list. The address of the first command block in the linked list is programmed through the I/O space. The Embedded DMA controller is instructed to fetch and execute the first command block through the I/O space command register. After performing the requested data operation, an address pointer in the first command block is used to fetch the second command block. An address pointer in each successive command block is used to fetch and execute the next command block, forming a linked list. Each command block in the linked list is executed until a NULL pointer is encountered. A NULL pointer is defined as an address consisting of all 1's. Upon detecting the NULL pointer, command block execution will halt, and a status bit will be set, indicating the command stream has terminated. Other status bits will indicate if the command stream has terminated normally with no errors, or abnormally due to errors. The status information may optionally generate an interrupt to the host.

The DMA engine can also be used for running diagnostics in the system. Known good data patterns can be loaded in Hub SRAM or known good DRAM and tested against other DRAM locations. Patterns can also be sent to the link to test it.

# Block Diagram of Hub

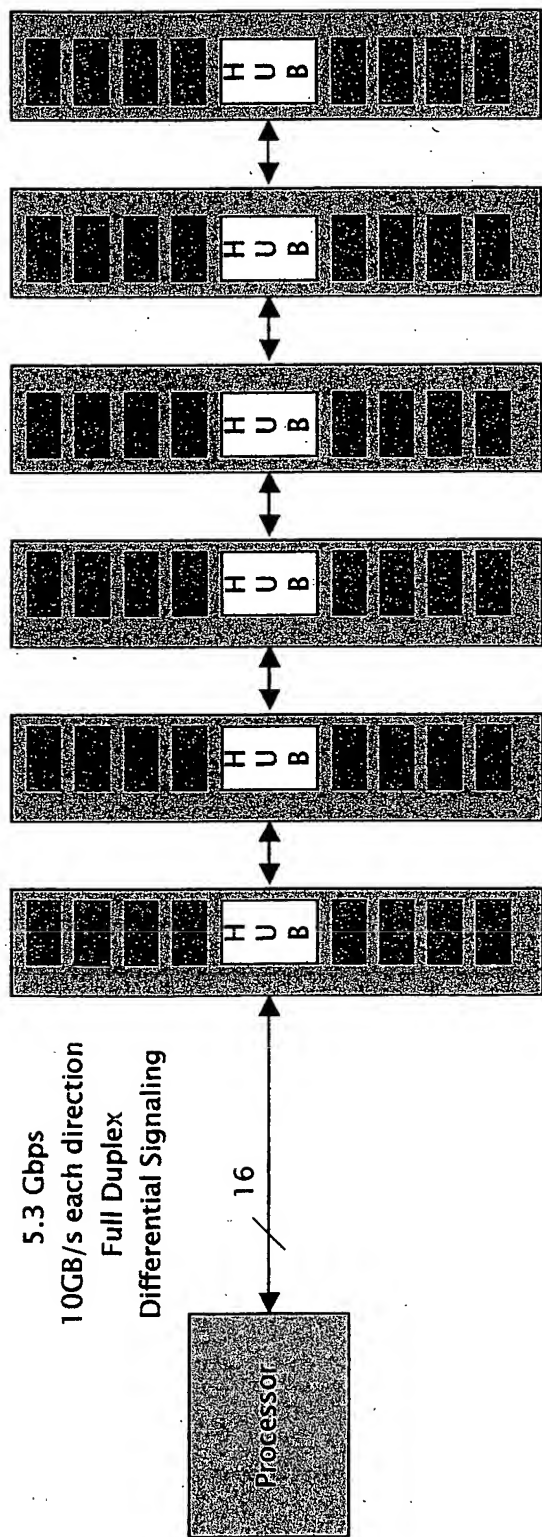


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# Hub System



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